THE IMPACT OF INTRAVENOUS FLUID PLUS ELECTROLYTE STANDARDIZATION ON TECHNICIAN WORKLOAD AT A COMPREHENSIVE CANCER CENTER

by

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Abstract

Purpose: Upon initial review of institutional practice over a 6-month period, it was determined that when utilizing an ordering tool within the electronic health record (EHR) for an intravenous (IV) fluid plus electrolyte(s), there were 606 various combinations that were compounded by technicians in the inpatient pharmacy setting. Variability in compounds have led to challenges in reusing returned doses, leading to an institutional initiative to standardize the options within an electronic ordering tool for an intravenous fluid plus electrolyte(s). The purpose of this study was to determine the impact of intravenous fluid plus electrolyte(s) standardization on pharmacy technician workload.

Methods: This pre- and post-implementation study included pre-data over a 6-month period (August 2018 – January 2019) and compared it to data 1-month post implementation (February 8, 2019 – March 8, 2019). Data was to be presented in weekly divisions of the months studied. The primary objective was to determine if a relationship exists between the percentage of weekly compounded doses and the number of weekly variable compounded fluid plus electrolyte combinations. The secondary objective was to assess the impact of the standardization on pharmacy technician workload.

Results: Data was presented as a percentage of the number of weekly compounded doses to total number of dispenses (compounded plus non-compounded doses) alongside the number of weekly variable compounded dose combinations. Descriptive statistics show that the mean percentage of weekly compounded doses was 0.67 (67%) and 0.39 (39%) over the pre- and post-implementation period, respectively. The mean number of weekly variable combinations was 38 and 18 over the pre- and post-implementation period, respectively. A linear regression showed statistical significance between the percentage of weekly compounded doses and the number of weekly variable compounded combinations ($p<0.001$). The mean number of doses compounded per week was 680 and 248 over the pre- and post-implementation period, respectively. Utilizing 5 minutes as the institutionally accepted metric for time to compound one dose, the pre- and post-implementation data shows a mean weekly compounding time of 3,400 minutes (57 hours) and 1,240 minutes (21 hours), respectively.

Conclusion: Standardization of the options within an electronic ordering tool for intravenous fluid plus electrolyte(s) resulted in a smaller percent of compounded doses, saving a mean of 36 hours/week, translating to 0.9 full-time equivalent (FTE) per week that may be re-allocated.

INTRODUCTION

A reduction of errors, minimization of excess costs, and limitation of order variability have all been observed outcomes of intravenous (IV) standardization.[1] In 2016, the American Society of Health-System Pharmacists (ASHP) launched the initiative, "Standardize 4 Safety", which began working to build a national consensus for standardized concentrations of IV medications. They predict that through standardization, turnaround dispense times will be decreased, streamline ordering will lead to more prescriber efficiency, and that standardization will minimize the burden of associated costs for hospitals and health-systems.[2]

Although ASHP does not include the standardization of electrolytes in their initiative, their principles and outcomes may still be applicable. Many institutions around the country have standardized electrolyte policies and protocols in place in order to optimize patient care. In 2009, a retrospective study evaluating the effectiveness and timeliness of electrolyte replacement in the Adult Intensive Care Unit (ICU) before and after implementation of an electrolyte replacement protocol was published. The study found that as a result of an electrolyte replacement protocol, the number of replacement doses of electrolytes, as well as the time to replacement, was significantly reduced.[3]

An assessment of electrolyte ordering practices at The University of Texas MD Anderson Cancer Center was completed to identify opportunities for electrolyte standardization. Providers order IV fluid plus electrolyte(s) within the electronic health record (EHR) via the following options:

- "Ready to Use" commercial intravenous electrolytes
- Commercial premix fluid and electrolyte combinations
- Three customizable IV fluid builders:
    - IV Fluid Builder (adult-inpt)
    - IV Fluid Builder (sodium acetate infusion)
    - IV Fluid Builder (sodium bicarbonate infusion)

Upon initial review of electrolyte ordering practices through each of these methods, it was determined that the majority of orders were placed through the IV Fluid Builder (adult-inpt) (n=25,868). The Division of Pharmacy selected the IV Fluid Builder (adult-inpt) to pilot an electrolyte standardization tool.

METHODS

Setting:

The University of Texas MD Anderson Cancer Center is a National Cancer Institute (NCI) designated Cancer Center located in the Texas Medical Center in Houston, Texas. At the main campus, there are 13 dispensing locations that service 681 inpatient beds. The Main Central Inpatient Pharmacy is a 24-hour, 7 day-a-week operation that dispenses roughly 19,000 doses a day, 1,300 of those doses being non-hazardous IV sterile products. The staffing model for the inpatient pharmacy dedicates 11 full-time equivalents (FTE) to non-hazardous sterile compounding across three shifts. The Main Central Inpatient Pharmacy compounds non-hazardous sterile products in an environment compliant with USP 797 requirements.

Study Implementation:

The Division of Pharmacy selected the IV Fluid Builder (adult-inpt) to pilot the standardization of IV fluid plus electrolyte(s). A group of four Clinical Pharmacy Specialists, two Drug Information Clinical Pharmacy Specialists, one Information Technology (IT) Specialist, and one Pharmacy Resident made up the core team of individuals tasked with proposing standardized concentrations of electrolytes. Further analysis of orders through the builder showed the greatest variability of doses compounded consisted of a fluid plus potassium chloride, potassium phosphate and/or magnesium sulfate. Selection of standardized

concentrations were led by recommendations from the Clinical Pharmacy Specialists who suggested from their professional experience and judgment what concentrations would be clinically appropriate for most patients who received care within the institution. The proposed standardized concentrations of potassium chloride were 20 mEq/L and 40 mEq/L; potassium phosphate 9 mmol/L, 15 mmol/L, 30 mmol/L; magnesium sulfate 16 mEq/L and 32 mEq/L.

Proposed standardized concentrations were taken to a larger group for discussion that included additional Clinical Pharmacy Specialists and Clinical Pharmacy Managers. Once approved by this group, the concentrations were then proposed to a Pharmacy IT Committee, MD Anderson Advanced Practice Practitioner (APP) Leadership, and the proposal was shared (not voted on) at the MD Anderson Pharmacy and Therapeutics (P&T Committee). Once the project was approved through all avenues listed, institutional education was sent out via email prior to implementation on February 8, 2019.

Figure 1 illustrates the view of the IV Fluid Builder (adult-inpt) prior to implementation of the intervention. As the image shows, when an additive was selected, the provider had the opportunity to enter free-text into the prompted blanks. Data analysis of the study period (August 2018- January 2019) showed free-text order entry ranged from 5 to 130 mEq/L of potassium chloride, 2 to 192 mEq/L of magnesium sulfate, and 7.5 to 90 mmol/L of potassium phosphate added to a base fluid. The total number of combinations compounded by pharmacy technicians in the inpatient pharmacy was 606 during the pre-implementation period.

Figure 1. IV Fluid Builder (adult-inpt) Pre-Implementation

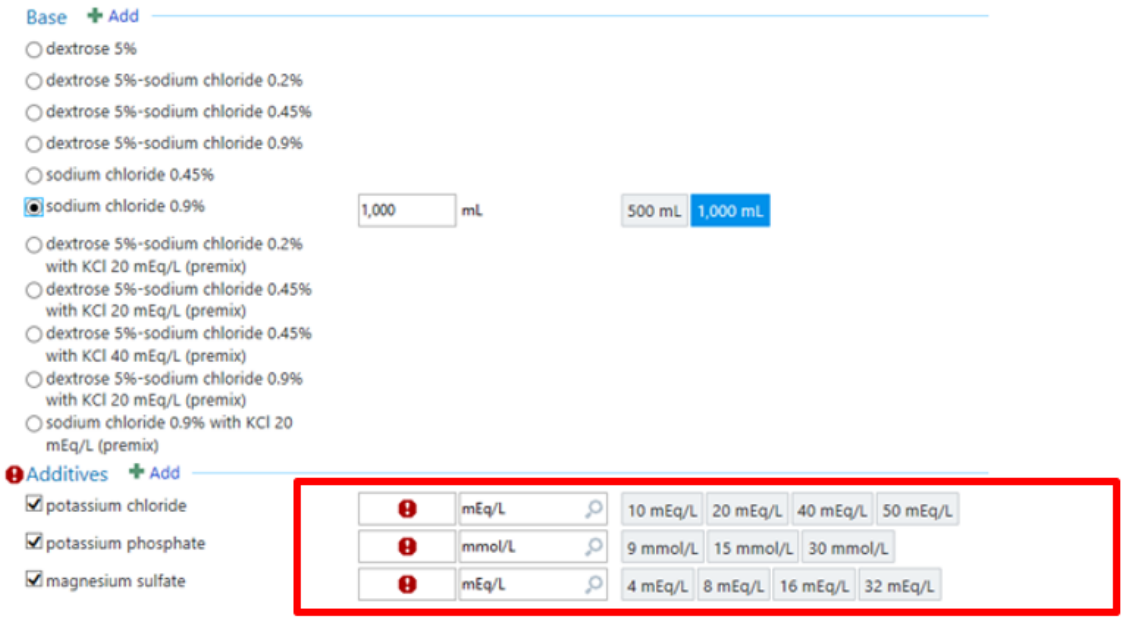
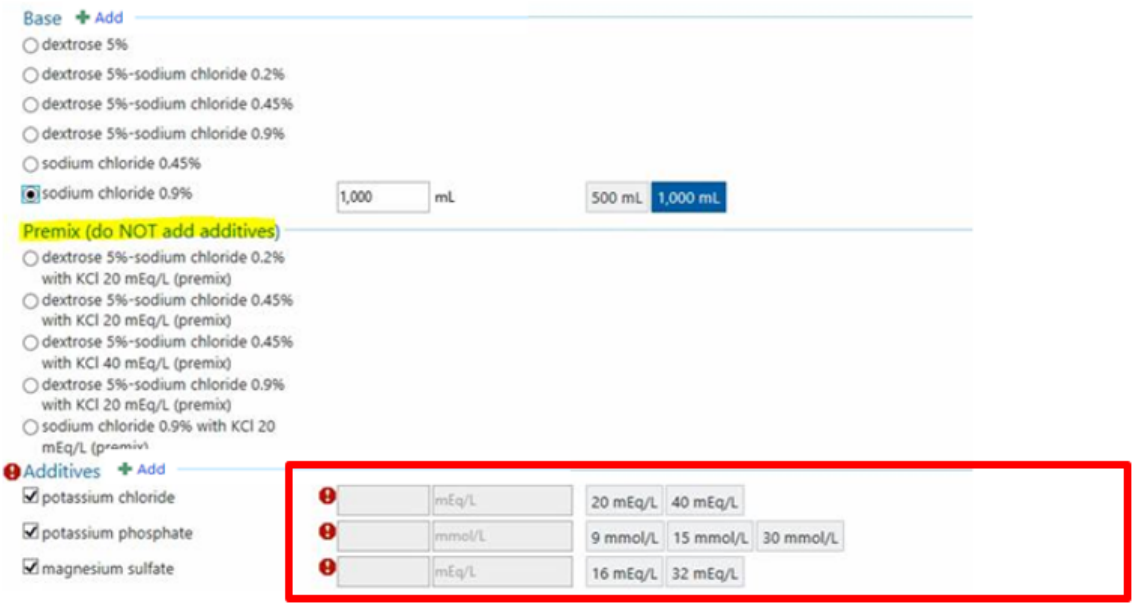


Figure 2 illustrates the view of the IV Fluid Builder (adult-inpt) post-implementation of the standardization concentrations. Providers had the free-text-entry option removed, and instead, have had dose selection buttons added to aid decision-making.

Figure 2: IV Fluid Builder (adult-inpt) Pre-Implementation



Study Design:

This pre- and post-implementation study included pre-data over a 6-month period (August 2018 – January 2019) and compared it to data 1-month post implementation (February 8, 2019 – March 8, 2019). Data was to be presented in weekly divisions of the months studied. The primary objective was to determine if a relationship exists between the percentage of weekly compounded doses and the number of weekly variable compounded fluid plus electrolyte combinations. The secondary objective was to assess the impact of the standardization on pharmacy technician workload.

Inclusion criteria was IV fluid plus electrolyte(s) compounded by pharmacy technicians within the MD Anderson Cancer Center Inpatient Pharmacy through the IV Fluid Builder (adult-inpt) containing potassium chloride, potassium phosphate and/or magnesium sulfate. Intravenous electrolyte compounds made from orders placed through alternative IV Fluid Builders were excluded. Additional exclusions included doses that were not compliant with the intervention in the post-implementation due to being part of a pre-existing oncology regimen-based treatment plan that was not impacted by the standardization tool.

Statistical Methods

Descriptive statistics were used to describe the data set analyzed. Inferential statistics included usage of a linear regression analysis to determine if a relationship exists between the percentage of weekly compounded doses and the number of weekly variable compounded fluid plus electrolyte combinations. Additionally, the impact of the standardization tool on pharmacy technician workload in the IV room of the inpatient pharmacy was performed by analyzing mean weekly compounding time over the pre- and post-implementation study period and multiplying by an institutionally accepted metric for pharmacy technician time to compound one dose.

RESULTS

Figure 3. shows the percentage of the number of weekly compounded doses to total number of dispenses (compounded plus non-compounded doses) alongside the number of weekly variable compounded dose combinations.

Figure 3: Pre- and Post-Implementation Compounded Doses and Combinations

	% Compounded	# of Compounded Combinations
8/3/18 - 8/9/18	0.62	47
8/10/18 - 8/16/18	0.64	34
8/17/18 - 8/23/18	0.72	35
8/24/18-8/30/18	0.73	33
8/31/18-9/6/18	0.70	35
9/7/18-9/13/18	0.78	47
9/14/18-9/20/18	0.72	43
9/21/18-9/27/18	0.71	49
9/28/18-10/4/18	0.74	36
10/5/18-10/11/18	0.68	44
10/12/18-10/18/18	0.61	40
10/19/18-10/25/18	0.69	40
10/26/18-11/1/18	0.71	40
11/2/18-11/8/18	0.71	44
11/9/18 - 11/15/18	0.75	45
11/16/18-11/22/18	0.73	42
11/23/18-11/29/18	0.67	38
11/30/18-12/6/18	0.69	41
12/7/18-12/13/18	0.65	40
12/14/18-12/20/18	0.65	35
12/21/18-12/27/18	0.58	24
12/28/18 - 1/3/19	0.58	22
1/4/19 - 1/10/19	0.68	36
1/11/19 - 1/17/19	0.66	37
1/18/19 - 1/24/19	0.57	31
1/25/19 - 1/31/19	0.65	34
2/8/19-2/14/19*	0.30	14
2/15/19 - 2/21/19*	0.45	18
2/22/19 - 2/28/19*	0.45	19
3/1/19 - 3/8/19*	0.40	24

*Refers to post-implementation data

Descriptive statistics show that the mean percentage of weekly compounded doses was 0.67 (67%) and 0.39 (39%) over the pre- and post-implementation period, respectively. The mean number of weekly variable combinations was 38 and 18 over the pre- and post-implementation period, respectively. The mean number of doses compounded per week was 680 and 248 over the pre- and post-implementation period, respectively. Utilizing 5 minutes as the institutionally accepted metric for time to compound one dose, the pre- and post-implementation data shows a mean weekly compounding time of 3,400 minutes (57 hours) and 1,240 minutes (21 hours), respectively.

Figure 4: Descriptive Statistics

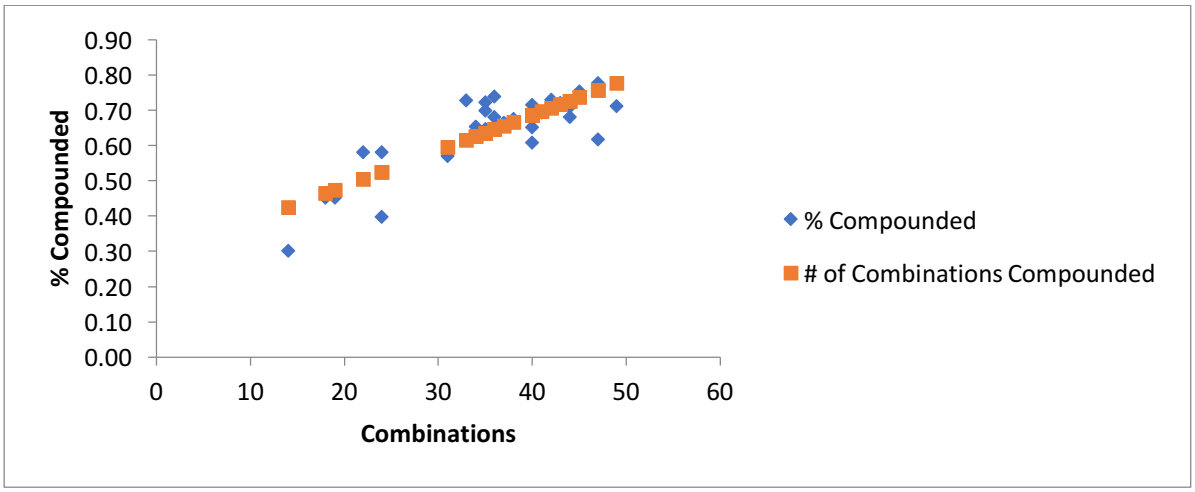
	Mean + (Standard Deviation)	**Range**
% Doses Compounded		
Pre-Implementation*	0.67 + (0.05)	0.57-0.78
Post-Implementation**	0.39 + (0.07)	0.30-0.45
Compounded Combinations		
Pre-Implementation*	38 + (6.5)	22-49
Post-Implementation**	18 + (4.1)	14-24
Weekly Doses Compounded		
Pre-Implementation*	680 + (155)	305-927
Post-Implementation**	248 + (65.5)	152-298

* Pre-implementation period covers August 2018- January 2019

* Post-implementation period covers February 8, 2019 – March 8, 2019

Figure 5 illustrates a linear regression showing statistical significance between the percentage of weekly compounded doses and the number of weekly variable compounded combinations ($p<0.001$).

Figure 5: Linear Regression Analysis



DISCUSSION

The standardization of intravenous electrolytes at the University of Texas MD Anderson Cancer Center provided preliminary results that a relationship exists between the percentage of weekly compounded doses and the number of weekly variable compounded fluid plus electrolyte combinations over the study period. Additionally, the secondary objective, assessing the impact of the standardization tool on pharmacy technician workload in the product compounding, showed favorable results to the intervention. The relationship between the two variables could be attributed to more opportunities to reuse returned bags due to decreased variability and uniqueness of compounds. Additionally, decreased number of dispenses may also be related to decreased changes of concentrations during a patient stay due to standardized options.

The lack of published data surrounding the impact of electrolyte standardization in an institutional setting adds strength to the study. Additionally, the number of dispenses each month exceeded 1000 orders, providing the study with a large sample size to test. However, there are limitations of the study, including that the post-implementation is a four-week period. This provides a challenge in the confirmation of statistical significance, and more data will be needed to be assessed before a definite conclusion can be reached.

CONCLUSION

Standardization of one provider entry ordering tool to order IV fluids with electrolytes resulted in a decrease in dosing variability in the number of IV fluid with electrolyte combinations. The intervention also showed a trend towards fewer compounded IV fluid with electrolyte dispenses, thus providing an opportunity for pharmacy technicians to lend time to provide services to other areas within the pharmacy and institution. Pre-implementation data showed the mean number of doses compounded per week was 680 and 248 over the pre- and post-implementation period, respectively. Utilizing 5 minutes as the institutionally accepted metric for time to compound one dose, the pre- and post-implementation data shows a mean weekly compounding time of 3,400 minutes (57 hours) and 1,240 minutes (21 hours), respectively. The difference in time amounts to 36 hours per week, translating to 0.9 FTE that could be allocated for other purposes.

Future directions for IV fluid with electrolyte(s) standardization at MD Anderson Cancer Center may be to extend this standardization across all IV Fluid Builders, in order to encompassing the outpatient areas. This study may be able to be used to support additional institutional standardization initiatives to optimize pharmacy workflows such as drug shortage management, improvements in waste and cost savings in both drug and personnel time.

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